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The Woolly Aphis and Its Repression.

Among the many diseases to which the apple tree is subject, none is as persistent and hard to eradicate and more wide-spread than the woolly aphis, *Schizoneura lanigera*. The home of this pest seems to be obscure. In England it is supposed to have come from America, and there it goes under the name of American apple blight. It is found in France and Germany, and wherever met is regarded as one of the most formidable of pests. The Chilian Consul of San Francisco stated several years ago that in Chili it had destroyed whole forests of the wild apple.

It seems almost unnecessary to describe this pest, unfortunately so common, yet a few words to novices in horticulture will not be out of place. In form the woolly aphis resembles closely the green aphis, so common on roses and other plants, but its color is reddish brown, and when crushed it yields a red juice, hence the German name *Blutlaus*, or blood louse. The insects are always surrounded by a whitish woolly substance, hence the name "woolly" aphis. Like all aphides, this species increases with astonishing rapidity, and only a few need be left on a tree, to soon spread all over it. While the presence of the woolly aphis makes itself so conspicuous above ground, on the branches, covering them as if with snow, yet the most serious trouble lies out of sight, at the roots, which in our dry climate they inhabit as freely as they do the branches, sapping the vitality of the tree to such an extent that the fruit becomes small and valueless. If allowed to go on unchecked the trees gradually die. To the apple tree the woolly aphis is what the phylloxera is to the grape vine, sucking and causing swellings and knobs all over the roots, as well as at the root crown.

A pest as serious as this has naturally been long fought, and many are the remedies suggested for its extermination. When young trees first become infested, and it is discovered in time, a number of remedies may be effectively used.

Rubbing or brushing kerosene on the infested spots, or washing them with lye, $\frac{1}{2}$ pound to the gallon, or with strong solution of whale oil soap, or sulpho-carbonate of potassium, may effectually arrest the disease. When, however, the roots of a large tree once become thoroughly infested (and in this State, unfortunately that requires but little time), almost all the remedies usually recommended prove wholly insufficient, and on a large scale impracticable. For a number of years we have tried at the experimental grounds of the University, various remedies, including tobacco decoction, hot water, common lime, ashes, bi-sulphide of carbon, and several proposed remedies of unknown composition, furnished by outside parties. Of the latter that of Mr. Lille, of San Francisco, appears, so far, quite promising. We must, however, reserve our judgment for some time yet.

Gas Lime.

On a whole, we have found no remedy as inexpensive and efficacious as gas lime—the refuse of gas works. Outside of its penetrating odor this material has but one objection; it is a strong medicine that must be used with care, and the dose must be regulated somewhat according to the soil and subsoil, and the age of the trees. There is necessarily some difference in its strength, according to its freshness, as it gradually loses some of its ingredients by exposure to the air, and especially to rain. Nevertheless, when applied to a given spot, it will retain its efficacy for at least three years. Our first experiments with it began four years ago, and at the convention held in San Francisco that year I made my first statement in regard to this remedy. I stated that a marked effect had been produced by it, and that the aphis had been killed, but that in spite of the very strong dose applied to each tree (something like ten pounds), the insects were again descending to the roots. I stated also that some of the trees on shallow soil had been killed by the gas lime, and that on the whole, the remedy was not satisfactory. During the succeeding spring and summer, however, I gained fresh confidence in it, as, with the exception of very weak trees or of those in shallow soil, comparatively few died,

those less injured showed returning vigor. The gas lime had also been very beneficial to the soil, causing the heavy, stiff loam to pulverize like ashes. The next season, after the first rain, I noticed the peculiar, strong odor of the gas lime. Examination later on, in the spring, showed that the aphid was not to be found about the roots, and existed right at the surface only. It evidently had not gained any headway. Altogether, the remedy now looked so promising that it was decided to give it a trial on a larger scale, but in much smaller doses; these, if proving sufficient, to be increased the next year. The call to take charge of the collection of plants for the New Orleans Exposition prevented me from carrying out my intentions at the time, and it was not until the past season (1885-6) that experiments properly guarded could be made.

The bad effect of the first application was to corrode the bark on the younger trees, causing it to decay. Instead of removing the soil and putting the gas lime in close contact with the tree, as was done the first time, there was spread about a shovelful and a half, *i. e.*, about two or three pounds in a dry state, within a radius of four feet over the surface around the tree, trusting to the rain to wash it into the soil. To prevent the aphid from remaining close on the root crown, fresh ashes, a few shovelfuls to each tree, were piled close about the trunk. The work was done early in October, and the copious rains of this season gave good opportunity for action.

On the trees examined thus far, the result has been very satisfactory. They show, by the knots and swellings on the roots, that they were once badly infested; still, there is no aphid on them now, while on a few other trees left without treatment the insects are crowded. Two rows of trees treated several years ago and now treated again, but having had no ashes placed about them, show the aphid working downward again. To make the work complete therefore, it seems necessary to use ashes or some similar material close about the root.

The dose of gas lime to be given to a tree should vary according to its size and age, and the nature of the soil. In a porous, deep soil there is less danger of injury than in a clayey one, where the water charged with the antidote permeates the soil very slowly, and has time to corrode the bark. In the case of some old trees in the Santa Cruz mountains treated last season, according to our suggestion, although the gas lime had been put right on the roots after the soil had been taken away, the roots were perfectly sound and all the aphid killed. The soil was a sandy loam, underlaid by limy sandstone. Thus, the exact dose to be recommended is a little difficult to determine. It is always safe to use a small dose first—from one shovelful on a small tree, to four on a very large one, spread over the surface, according to the spread of the root, will generally be found right.

It should be stated that a thorough treatment

of the top was never made, because we wanted to see how far we could depend upon the lady-bug for extermination there. From observations during the last few years, I believe that in this locality this useful little beetle can be depended upon for keeping the crown of the tree free from aphid. We cannot recommend too highly the protection of the lady-bugs, *Coccinellæ*. During more than one year, we have seen them completely annihilate the aphid above ground in a very few days. It is generally stated that their larvæ are the most destructive to the latter. We ourselves have witnessed what an enormous quantity of aphid the fully developed lady-bug will consume. As the *Coccinellæ* hibernate on evergreen trees, I very strongly recommend the planting of these trees, (conifers, especially) around the orchard, to give the necessary shelter. I have often seen them congregated on the Monterey cypress in such quantities that they could be taken up by the handful. Should the lady-bugs not appear in numbers sufficient to exterminate the aphid, it may be necessary to kill the latter by means of washes. As it is impossible to accomplish this with one spraying on badly infested trees, I recommend two or three sprayings. This should be done in the following manner: For the first application use hot water of 140° F., in the tank sprayed with great force. This will wash off the greater number of the insects. For the second application take tobacco water and whale oil soap in the following proportions: in a decoction of tobacco (one gallon water to one-half pound tobacco) put half a pound of whale oil soap. Apply this mixture at about 130° F.; in about a week give another similar application. If early varieties of apples are in question, leave out the whale oil soap, as, especially in a cool climate the odor of the whale oil will not leave the fruit.

Resistant Stock.

There is a vast difference in the many varieties of apples as regards their resistance to the woolly aphid. The late John Llewelling, of Napa, claims to have found by experience that seedlings of Golden Russet and Rawle's Janet are exempt. We have no personal experience in the matter, but for several years, at the experimental grounds of the University, we have had growing two apple trees of an unnamed variety, propagated and donated by John Rock, of San Jose. Although purposely and repeatedly infected with the woolly aphid, these insects never remained either on the top or on the roots. The latter are tough and wiry, and perhaps for this reason resist the aphid, much as the wiry grape roots resist the phylloxera. The only manner in which this resistant variety can now be propagated is by grafting. Although healthy, these trees have been of rather slow growth. Doubtless there are among the many varieties of apples others equally resistant, and it would be well to pay close attention to this point. W. G. KLEE.

Berkeley, May 6, 1886.